

What is claimed is:

1. A method for preparing a fatty acid ester comprising reacting fats and oils with a monohydric alcohol under conditions where the monohydric alcohol is in a supercritical state, wherein  
5 a reaction mixture containing unreacted reactants and/or intermediate products is recycled to the reactor.

2. The method according to claim 1 which further comprises a step of removing the fatty acid ester from the reaction mixture prior to being supplied to the reactor.

10 3. The method according to claim 2, which comprises the steps of:

(A) supplying fats and oils and a monohydric alcohol in a reactor;

15 (B) reacting the fats and oils with the monohydric alcohol under conditions where the monohydric alcohol is in the supercritical state to obtain a reaction mixture;

(C) removing the monohydric alcohol from the reaction mixture obtained in step (B) to obtain an alcohol-free reaction mixture;

20 (D) separating the alcohol-free reaction mixture obtained in step (c) to a light liquid containing the fatty acid esters and a heavy liquid containing glycerol;

(E) removing the fatty acid esters from the light liquid obtained in step (D) to obtain an unreacted material liquid  
25 containing the unreacted reactants and/or intermediate products; and

(F) supplying the unreacted material liquid obtained in step (E) to the reactor.

4. The method according to claim 2, which comprises the steps of:

(A) supplying fats and oils and a monohydric alcohol in a reactor;

5 (B) reacting the fats and oils with the monohydric alcohol under conditions where the monohydric alcohol is in the supercritical state to obtain a reaction mixture;

(G) separating the reaction mixture obtained in step (B) to a light liquid containing the fatty acid esters and a heavy  
10 liquid containing glycerol;

(H) removing the monohydric alcohol from the light liquid obtained in the step (G) to obtain an alcohol-free light liquid;

(I) removing the fatty acid esters from the alcohol-free light liquid obtained in step (H) to obtain an unreacted material  
15 liquid containing the unreacted reactants and/or intermediate products; and

(J) supplying the unreacted material liquid obtained in step (I) to the reactor.

5. The method according to any one of claims 1 to 4, wherein  
20 said monohydric alcohol is an alcohol of the formula:



wherein R is a hydrocarbyl group having 1 to 10 carbon atoms, or a hydrocarbyloxyl group-substituted hydrocarbyl group having 2 to 10 carbon atoms in total.

25 6. An apparatus for preparing a fatty acid ester comprising reacting fats and oils with a monohydric alcohol in a reactor under conditions where the monohydric alcohol is in a supercritical state, wherein the apparatus has a mechanism for recycling a

reaction mixture containing unreacted reactants and/or intermediate products to a reactor.

7. The apparatus according to claim 6, which further comprises a separation means to isolate the fatty acid ester from  
5 the reaction mixture.

8. The apparatus according to claim 7, which comprises

(a) a means for supplying fats and oils and a monohydric alcohol in a reactor;

(b) a reactor in which the fats and oils are reacted with  
10 the monohydric alcohol under conditions where the monohydric alcohol is in the supercritical state to obtain a reaction mixture;

(c) a separation means for removing the monohydric alcohol from the reaction mixture obtained in the reactor (b) to obtain an alcohol-free reaction mixture;

(d) a separation means for separating the alcohol-free  
15 reaction mixture obtained with the separation means (c) to a light liquid containing the fatty acid esters and a heavy liquid containing glycerol;

(e) a separation means for removing the fatty acid esters  
20 from the light liquid obtained with the separation means (d) to obtain an unreacted material liquid containing the unreacted reactants and/or intermediate products; and

(f) a means for supplying the unreacted material liquid obtained with the separation means (e) to the reactor (b).

25 9. The apparatus according to claim 7, which comprises

(a) a means for supplying fats and oils and a monohydric alcohol in a reactor;

(b) a reactor in which the fats and oils are reacted with

the monohydric alcohol under conditions where the monohydric alcohol is in the supercritical state to obtain a reaction mixture;

(g) a separation means for separating the reaction mixture obtained in the reactor (b) to a light liquid containing the fatty acid esters and a heavy liquid containing glycerol;

(h) a separation means for removing the monohydric alcohol from the light liquid obtained with the separation means (g) to obtain an alcohol-free light liquid;

(i) a separation means for removing the fatty acid esters from the alcohol-free light liquid obtained with the separation means (h) to obtain an unreacted material liquid containing the unreacted reactants and/or intermediate products; and

(j) a means for supplying the unreacted material liquid obtained with the separation means (i) to the reactor (b).